DOI 10.18551/rjoas.2021-04.16

PRELIMINARY YIELD TRIAL OF PADI AYU 2 UNJA MUTANT STRAIN ON RAIN-FED LOWLAND AGRO-ECOSYSTEM IN ITS VEGETATIVE STAGE

Aryunis*, **Wiskandar**
Department of Agroecotechnology, Faculty of Agriculture, University of Jambi, Indonesia
*E-mail: aryunis_oeddin@yahoo.com

ABSTRACT
The objective of the Preliminary Yield Trial (PYT) of Padi Ayu 2 UNJA mutant strain on rain-fed lowland agroecosystem in the vegetative stage was to obtain Padi Ayu 2 UNJA mutant strain with the following characteristics: high survival rate, short stems, and multiple sprouts. The mutant strain was a breakthrough for the in situ rice production technology. It was considered as a new local-wisdom-based superior variety suitable for a rain-fed lowland agroecosystem. The new superior variety has high yield potential and can be used as a sustainable in situ rice cultivation technology. During the study, the agroecosystem in which the mutant strain grew was not irrigated. Rain becomes the only water supply. The selection was carried out on a pedigree basis to describe the components of vegetative growth. The objective was to identify specific characteristics of Padi Ayu 2 UNJA that has a high yield and high tolerance toward rain-fed lowland agroecosystem.The results reported four Padi Ayu 2 UNJA mutant strains having high tolerance toward the agroecosystem. Their characteristics were short stems (93.11-97.44 centimeters) and high-yielding ability cultivars (30.38-36.50 cultivars). KD2, KD3, KD4, and KD5 Padi Ayu 2 UNJA are potential mutant strains with high yield in rain-fed lowlands agroecosystem.

KEY WORDS
Preliminary yield trial, Padi Ayu 2 UNJA mutant strain, rain-fed lowland agroecosystem, vegetative growth stadia.

Rice is the most important cereal crop globally as it is the staple food of nearly half of the world's population. About 30% of the world's rice (*Oryza sativa*) is produced on agricultural land located at low elevation and depends upon rainfall as irrigation (Bailey-Serres et al., 2010). Global climate change has disrupted the rainfall, and as a result, it is difficult to predict when exactly flash floods and severe droughts occur to anticipate their effects. In general, several rice plants have low drought resistance because they require a lot of water. The molecular genetic analysis detected some locus traits associated with drought tolerance components: grain production, shoot and root morphology, and leaf water status (Lanceras et al., 2004; Yue et al., 2006; Venuprasad et al., 2009). Global climate change affects rainfall and causes severe drought. Therefore, we should develop rice cultivars that can stand these conditions. One method is to develop cultivar from local cultivar with high heavy rainfall and drought tolerance as genetic.

Rain-fed lowland (sub-optimal land) can grow early-age rice plants that can stand the global warming effects. Padi Ayu 2 UNJA is an M5 mutant strain of local rice (*padi lokal*) KD from Jambi, well-known for producing fluffy rice (Aryunis, Esrita, and Tafzi, 2004). The Preliminary Yield Trial (PYT) objective on Padi 2 Ayu UNJA in rain-fed lowland as agroecosystem is to obtain mutant strain from the variety. Padi Ayu 2 UNJA has a high tolerance and, as a result, can increase rice productivity in the agroecosystem. The mutant strain results from local wisdom-based in situ innovation to use rain-fed lowland agroecosystem to increase rice production sustainably.

MATERIALS AND METHODS OF RESEARCH

The study was conducted in local farmers-owned rain-fed lowland in Pembengis Village, Bram Itam Region, Tanjung Jabung Barat. The characteristics of the land were: soil

acidity level = 3.5-5.5, slope = 0 %, height (ASL) = 0-0.01 m, peat depth = 0.5-1 m. Rainfall = Wet 65 %, Dry 35 % (Anonymus, 2020). The study was conducted from March until October 2019. The materials were five mutant seeds of M6 Padi Ayu 2 UNJA, resulting from PYT in rain-fed lowland as agroecosystem. Their codes were KD1-2/5PsJ-M5-1-UDHP-M6-1-RW-BTGH-Jambi-2018, KD2-4/3PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018, KD3-12/7PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018, KD4-14/18PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018 and KD5-14/19PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018.

Preliminary Yield Trial (PYT) selection of M6 Padi Ayu 2 UNJA mutant strain was conducted on pedigree basis using the following characteristics: short stems, compact rice panicles, short growing time, and high yield potential. The rice field, where the mutant strain grew, was not irrigated during the study. Water supply relied upon rain. The weather was hot for two months during the vegetative stadia with the highest temperature of 45ºC. The criteria used in this PYT were high production and specific agronomic characteristics. The cultivation technique matched the standard operating procedure for rice cultivation in rain-fed lowland applied by the local. The study used a Randomized Block Design with four (4) replications. The expected result of this study was to obtain a mutant strain that could adapt to rain-fed lowland agroecosystem well.

The researchers analyzed the morphological characteristics of vegetative growth to identify the characteristics of the mutant strain of Padi Ayu 2 UNJA toward the rain-fed lowland agroecosystem. The analysis included analysis on (1) the height of the cultivar**,** (2) the survival rate, (3) the height of the stem, and (4) the maximum number of cultivars.

Univariate Analysis of Variance (ANOVA) was conducted to find out the adaptability of the mutant strain. Furthermore, a mean comparison test with DMRT (Duncan Distance Test) at a 5% significance level was conducted to determine the difference between treatments.

RESULTS AND DISCUSSION

The elements analyzed in the Preliminary Yield Trial (PYT) on Padi Ayu 2 UNJA toward rain-fed lowland during vegetative growth stadia were cultivar height, survival rate, stem height, and maximum number of cultivars (Table 1,2, 3, and 4)

Table 1 – Cultivar Height of M6 Padi Ayu 2 UNJA mutant strain toward Rain-fed Lowland Agroecosystem in 21 Days after Sowing (DAS)

Serial Number	Mutant Strain Number	Selected M6 Padi Ayu 2 UNJA Mutant Strain Code	Cultivar Height (cm)
1	1	KD1-2/5PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	37.00 b
2	2	KD2-4/3PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	36.58 b
3	3	KD3-12/7PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	37.58 b
4	4	KD4-12/7PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	38.75 b
5	5	KD5-14/19PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	36.46 b
6	Inpara3	Superior Variety as Comparison	41.17 a

Note: The numbers followed by lowercase letters were not significantly different at the 5% significance level based on the DNMRT test.

Table 1 depicts the height of the selected mutant strains toward the rain-fed lowland agroecosystem, between 36.46 and 38.75 centimeters or shorter than in Inpara 3 (41.17 centimeters).

Table 2 – Survival Rate of M6 Padi Ayu 2 UNJA mutant strain toward Rain-fed Lowland Agroecosystem in 70 Days after Planting (DAP) (vegetative stadia)

Serial Number	Mutant Strain Number	Selected M6 Padi Ayu 2 UNJA Mutant Strain Code	Survival Rate (%)
1	KD1	KD1-2/5PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	74.55 b
2	KD2	KD2-4/3PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	78.03 ab
3	KD3	KD3-12/7PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	83.44 ab
4	KD4	KD4-14/18PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	87.26 a
5	KD5	KD5-14/19PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	80.45 ab
6	Inpara3	Superior Variety as Comparison	79.44 ab

Note: The numbers followed by lowercase letters were not significantly different at the 5% significance level based on the DNMRT test.

Table 2 showed that the survival rates of KD2, KD3, KD4, KD5, and Inpara 3 were between 78.03% and 87.26% (moderate), and that of KD1 was 74.55% (low) (IRRI, 1988).

Table 3 – Stem Height of M6 Padi Ayu 2 UNJA mutant strain toward Rain-fed Lowland Agroecosystem in 70 Days after Planting (DAP) (flowering stage)

Serial Number	Mutant Strain Number	Selected M6 Padi Ayu 2 UNJA Mutant Strain Code	Stem Height (cm)
1	1	KD1-2/5PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	97.17 a
2	2	KD2-4/3PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	93.11 a
3	3	KD3-12/7PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	94.89 a
4	4	KD4-14/18PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	97.44 a
5	5	KD5-14/19PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	94.94 a
6	Inpara3	Superior Variety as Comparison	72.25 b

Note: The numbers followed by lowercase letters were not significantly different at the 5% significance level based on the DNMRT test.

Table 3 shows that the stem height of M6 Padi Ayu 2 UNJA mutant strains was between 93.11 and 97.44 centimeters or significantly higher than that of Inpara 3 (72.25 cm) (Tabel 3). Based on IPBGR-IRRI (1980) and Chang and Bardenas (1965), their height (the selected strains and Inpara3) was considered high.

Table 4 depicts the number of cultivar of the mutant strain, between 30.38 and 36.50 cultivars. The number was significantly higher than that of Inpara 3 (18.25 cultivars). Based on IPBGR-IRRI (1980) and Chang and Bardenas (1965), the cultivar number of the five mutant strains was high, and Inpara3 was moderate.

Table 4 – Maximum Number of Cultivar (early flowering stadia) of M6 Padi Ayu 2 UNJA mutant strain toward Rain-fed Lowland Agroecosystem in 70 Days after Planting (DAP)

Serial Number	Mutant Strain Number	Selected M6 Padi Ayu 2 UNJA Mutant Strain Code	Number of Cultivars
1	1	KD1-2/5PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	36.38 a
2	2	KD2-4/3PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	36.50 a
3	3	KD3-12/7PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	31.63 a
4	4	KD4-14/18PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	30.38 a
5	5	KD5-14/19PsJ-M5-UDHP-M6-1-RW-BTGH-Jambi-2018	32.13 a
6	Inpara3	Superior Variety as Comparison	18.25 b

Note: The numbers followed by lowercase letters were not significantly different at the 5% significance level based on the DNMRT test.

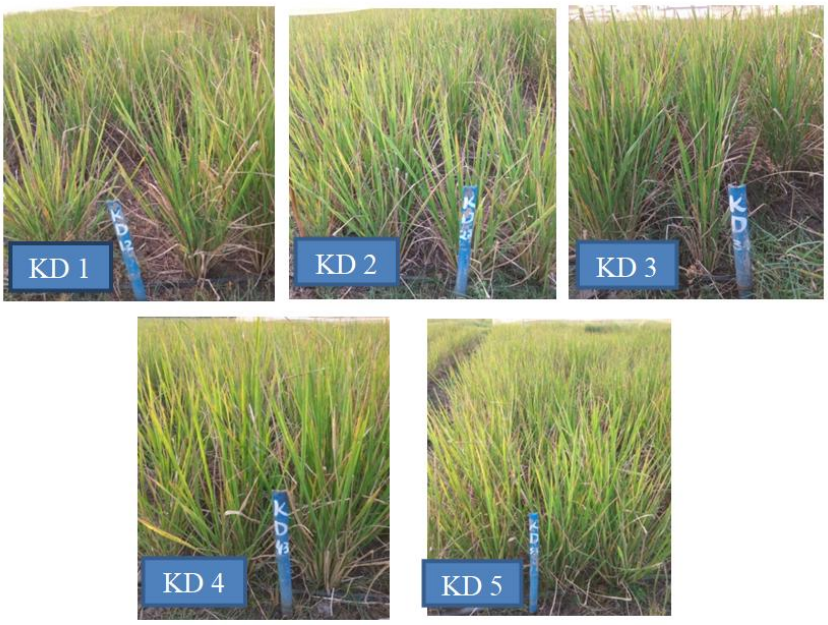

Figure 1 – M6 Padi Ayu 2 UNJA mutant strain growth in late vegetative stadia (70 DAP) in rain-fed lowland agroecosystem during the dry season

The findings showed that the five M6 Padi Ayu 2 UNJA mutant strains did not have different morphological characteristics (cultivar and stem height, and the number of cultivars) in the vegetative growth stage toward the rain-fed lowland agroecosystem. However, there was a significant difference in the cultivar's height and the maximum number of cultivar between the mutant strain and Inpara 3 (Table 1, 3, and 4) toward the agroecosystem. M6 KD1 had a lower survival rate than M6 KD2, KD3, KD4, KD5, and Inpara 3 (Table 2). These data indicated that M6 Padi Ayu 2 UNJA mutant strains were homogenous and had genetic stability and high productivity in the sub-optimum environment (rain-fed lowland agroecosystem). Based on IBPGR-IRR1 (1980), the five mutant strains of M6 Padi Ayu 2 UNJA had short stem (93.11- 97.44 cm) and high cultivars (30.38 – 36.50 cultivars).

Figure 1 showed morphological characteristics of the mutant strain characteristics in vegetative growth stadia in 70 Days After Planting (DAP).

CONCLUSION

Four mutant strains of M6 Padi Ayu 2 UNJA, namely KD2, KD3, KD4, and KD5, have a high survival rate, short stems (93.11- 97.44 cm), and high cultivars (30.38 - 36.50 cultivars). It means the mutant strains can adapt to rain-fed lowland agroecosystem, and as a result, has high productivity.

ACKNOWLEDGMENTS

The authors would like to thank the Rector and Head of Research and Community Service Center of Univesity of Jambi for the research funding (DIPA PNBP LP2M University of Jambi). The authors also would like to send appreciation to the PAIR BATAN Rice Research Team to assist in the radiation and mutation process of the local variety of rice (*padi lokal*) KD Jambi, and Mr. H. Junaidi, and Mr. Karim for lending their land and provided assistance during the study.

REFERENCES

1. Anonymous, 2020. Program Desa Pembengis.Kecamatan Bram Itam Kabupaten Tanjung Jabung Barat Propinsi Jambi.
2. Aryunis, Esrita dan F. Tafzi. 2004. Eksplorasi Padi Lokal Pasang Surut dengan Rasa Nasi Enak di Kabupaten Tanjung Jabung Barat Provinsi Jambi. Laporan Penelitian Universitas Jambi.
3. Bailey-Serres J, Voesenek LACJ. 2010. Life in the balance: a signaling network controlling survival of flooding. Curr Opin Plant Biol 13:489-494.
4. Chang, T., T., and Bardenas, E., A, 1965 The morphology and variety characteristics of the rice plant. IRRI Tech. Bull. (4).
5. IBPGR-IRR1. 1980. Descriptors for rice *Oryza sativa* L. IRRI, Manila, Philippines.
6. IRRI, 1988. Standard evaluation systems for rice. IRRI, Manila, Philippines.
7. Lanceras, J.C., Pantuwan, G., Jongdee, B., and Toojinda, T. 2004. Quantitative trait loci associated with drought tolerance at reproductive stage in rice. Plant Physiol. 135: 384–399.
8. Venuprasad, R., Dalid, C.O., Del Valle, M., Zhao, D., Espiritu, M., Sta Cruz, M.T., Amante, M., Kumar, A., and Atlin, G.N. 2009. Identification and characterization of large-effect quantitative trait loci for grain yield under lowland drought stress in rice using bulk-segregant analysis. Theor. Appl. Genet. 120: 177–190.
9. Yue, B., Xue, W., Xiong, L., Yu, X., Luo, L., Cui, K., Jin, D., Xing, Y., and Zhang, Q. 2006. Genetic basis of drought resistance at reproductive stage in rice: Separation of drought tolerance from drought avoidance. Genetics 172: 1213–1228.